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Planting Depth of Hybrid Poplar Cuttings Influences Number of Shoots

Edward Hansen, David Tolsted, and Matthew Tower

ABSTRACT.—Reports that planting unrooted hybrid poplar cuttings flush with the soil surface resulted in significantly fewer multiple-stem shoots compared to letting the cuttings protrude 2.5 or 5.0 cm above the soil surface. There were no significant effects on shoot height growth or cutting mortality.

KEY WORDS: Multiple shoots, single stems, SRIC, biomass

Hybrid poplar plantations are typically established by planting unrooted hardwood cuttings (Dickmann and Stuart 1983, Hansen *et al.* 1983). These cuttings often produce several shoots and develop into multiple-stem trees, which are generally suitable only for fuelwood. Although small multiple-stem trees can be chipped for pulp, there are few markets for chips containing bark. However, single-stem trees can be marketed as either pulpwood or fuelwood.

A second advantage of single-stem over multiple-stem trees is reduced site impact from nutrient removal during harvesting. Small trees, such as multiple-stem trees, have larger amounts of twigs and branches and a higher bark-to-wood ratio than larger trees (Carter and White 1971). This greater percentage of small branches and higher bark ratio results in higher concentrations of nutrients in multiple-stem trees and consequently increased nutrient removal (Hansen and Baker 1979). Therefore, cultural techniques that promote single-stem trees need to be developed. It has been observed that the frequency of multiple-stem trees seems to increase as more of the cutting's length is left exposed above the soil surface. We conducted a study to test the hypothesis that the percentage of trees with multi-stems is related to planting depth of the cutting. The effect of planting depth on mortality was also investigated.

Edward Hansen is a Silviculturist, **David Tolsted** is a Technician, and **Matthew Tower** is a Temporary employee with the North Central Forest Experiment Station, Grand Rapids, MN.

METHODS

The study area was located at the North Central Forest Experiment Station's Harshaw Forestry Research Farm near Rhinelander, Wisconsin. Before its development as a forestry research area, the Harshaw Farm had a 50-year history as a potato farm. Soils are Padus loam (mixed, frigid, coarse loamy Alfic Haplorthod). Soil texture ranges from a silt loam to a sandy loam with a plow layer at 25 cm and a pH ranging from 6 to 7.

The planting site was prepared in the fall of 1989 by moldboard plowing, disking, and harrowing. Additional site work consisted of applying a contact herbicide (glyphosate) at 1.1 kg (active ingredient)/ha just before planting on May 24, 1990, and applying a pre-emergent herbicide (linuron) at 2.2 kg (active ingredient)/ha immediately after planting to ensure that the plot would not be disturbed by mechanical weed control during the study period. Unrooted hardwood cuttings 25 cm long were used as the planting

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material. The cuttings were planted in a randomized block design with three replications and four clones in each replication. The clones were *P. deltoides* x *nigra* (DN-170), *P. deltoides* x *nigra* (DN-154), *P. candicans* x *P. berolinensis* (NE-387), *P. charkowiensis* x *P. caudina* (NE-20). Ten cuttings of each clone were planted at each of three planting depths: flush with the soil surface, protruding 2.5 cm, and protruding 5.0 cm above the soil surface. The cuttings were planted at 30 cm spacing in rows 60 cm apart. We planted a total of 360 cuttings, 90 cuttings per clone.

Two months after planting, the cutting length protruding above the soil surface was remeasured and checked for significant or variable soil settling. Also, the number of shoots per cutting was recorded, and shoot heights were measured. Two measures of multiple stems were calculated: "percent with multiple stems," which was the number of cuttings out of the 10 cuttings of each clone at each depth that had more than one shoot, and "stems per cutting" which was the average number of stems per cutting for the population of 10 cuttings. All statistical tests were by ANOVA, and significance was determined at $p = 0.05$.

RESULTS AND DISCUSSION

The remeasurement 2 months after planting showed no appreciable differences between the exposed cutting lengths and the original planting specifications.

There were no significant differences between replications in either single-stem frequency, mortality, or growth. The relation of stems per cutting to length of cutting above the soil surface was highly significant. As more of the cutting was left exposed above the soil surface, the number of shoots increased markedly (fig. 1). The 0-cm treatment produced the least number of stems per cutting (1.2). The 2.5-cm treatment produced slightly more, while the 5.0-cm treatment produced the greatest number of stems per cutting (1.9).

The relation of percent of cuttings with multiple stems to the length of cutting above the soil surface is also highly significant. Again, the percent of cuttings with multiple stems increased as more of the planted cutting was exposed above the soil surface (fig. 2). On average, only 15 percent of cuttings in the 0-cm treatment had

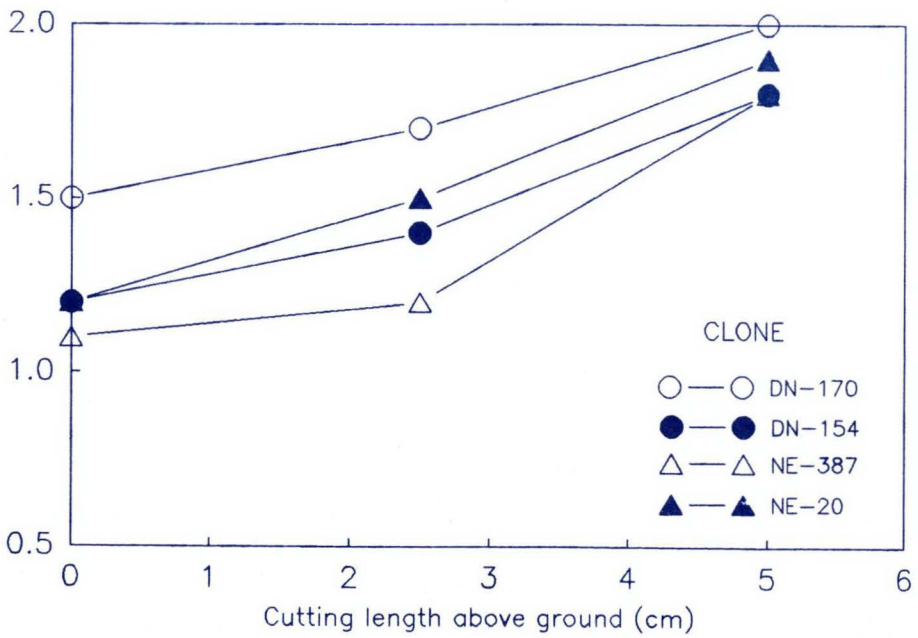

Figure 1.—*Relation of number of stems per cutting to length of cuttings above soil surface, 2 months after planting.*

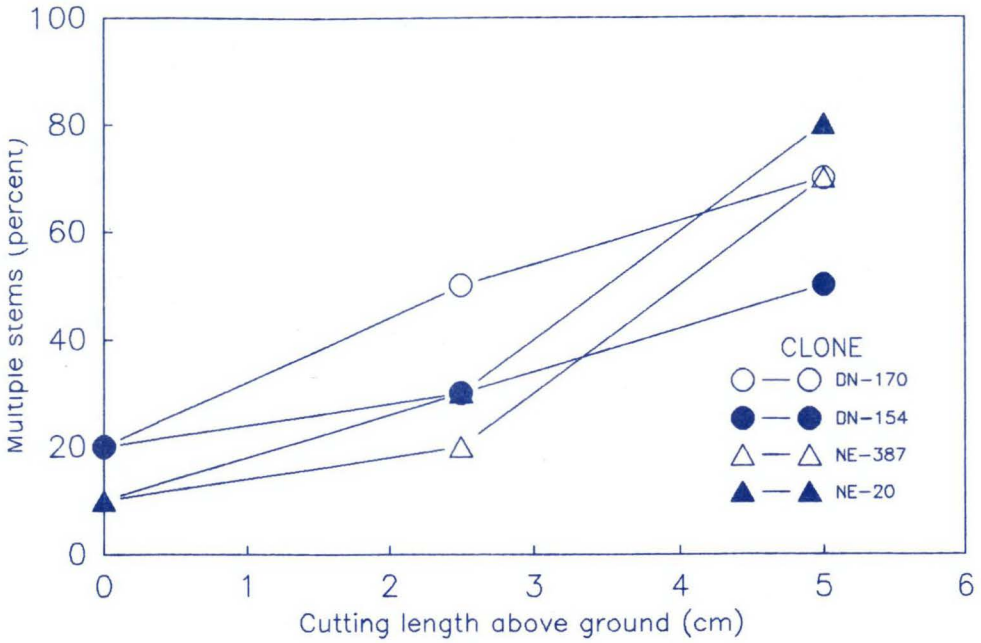

Figure 2.—*Relation of percent of cuttings with multiple stems to length of cutting above soil surface, 2 months after planting.*

multiple stems, but 25 percent of the 2.5-cm treatment and 68 percent of the 5.0-cm treatment had multiple stems. Clones were significantly different in both number of stems per cutting and in percent of cuttings with multiple stems. The interaction of planting depth and clone was not significant, however, indicating that all clones tended to act the same in relation of multiple stems to planting depth.

There is an indication of slightly reduced cutting mortality with the 5.0-cm treatment (fig. 3); however, the relation was not significant. Also, the relation of planting depth to shoot height

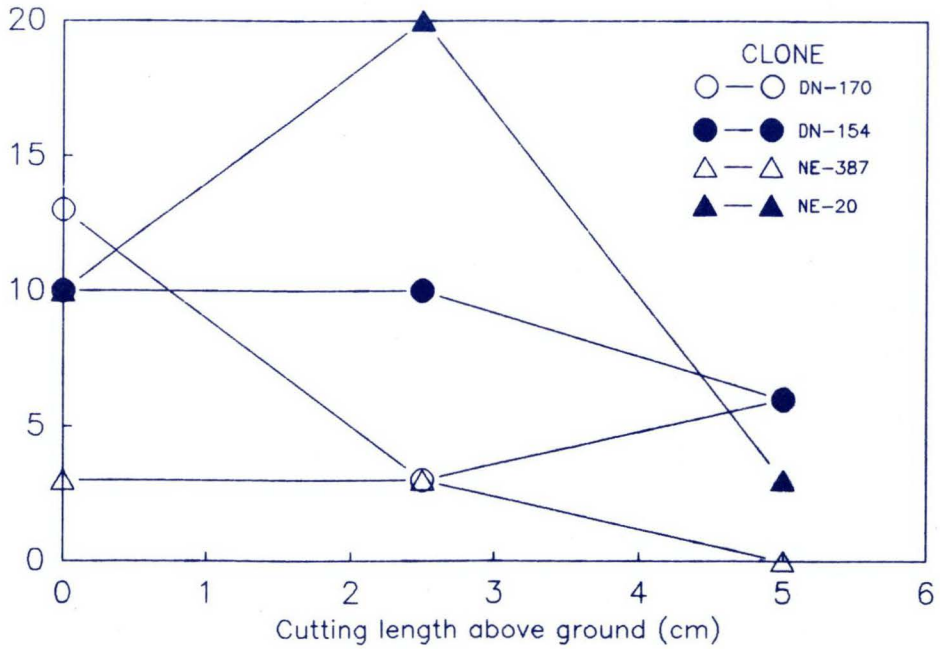

Figure 3.—*Relation of percent mortality to length of cutting above soil surface, 2 months after planting.*

growth at 2 months was not significant (data not shown). It is possible that if biomass or production of cuttings were of primary concern, multiple shoots might have greater early production than single-stem shoots. This issue was not addressed by this study.

CONCLUSION

The occurrence of multiple-stem hybrid poplars originating from unrooted hardwood cuttings can be controlled to a large extent by planting technique. Cuttings planted flush with the soil surface rather than left protruding above ground will tend to produce single-stem trees. As cuttings protrude more above the soil surface, the frequency of multiple shoots will increase. The occurrence of multiple stems increased up to the maximum tested cutting length left protruding above the soil surface (5.0 cm in this study). Planting depth had no significant effect on either height growth or mortality.

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